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## **Dynamics of the Stabilization Process after Argentine Hyperinflation in 1985**

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### **ABSTRACT.**

During the first years of the 80's decade, the continual financing of the Argentine deficit fiscal, throughout the emission of new money, pushed Argentina to the verge of hyperinflation. In June 1985, the seriousness of such a situation compelled the governing party, the Union Civica Radical, to adopt hard policies of stabilization, afterwards known as Plan Austral. In this article a SD version of a small dynamic model is presented - in Cagan's tradition (1956), conceived by Fernandez and Mantel (1985)- of the mentioned Argentine stabilization process. Dynamic simulation is used to analyse the macroeconomic behaviour.

### **INTRODUCTION**

After describing the fundamental facts which characterized the Argentine inflationary process foregoing the application of Plan Austral in 1985, an economic model is presented -Cagan type (1956), planned by Fernandez and Mantel (1986)- which discusses the budget role in the inflationary process, simultaneously incorporating Wicksell's idea that inflation adjusts proportionally to the difference between natural and real interest rate. The following section states in SD terms the previously exposed model and finally, some experiments with the model which resembles the Plan Austral application are presented.

### **FINANCING OF THE PUBLIC SECTOR DEFICIT.**

For the Classics, who ignore the existence of a Central Bank, the only way of financing public sector deficits, is through transitory government indebtedness, emitting debt in



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crisis periods and redeeming debt in superavit periods. For Keynesian thought, deficit could also be financed by monetary emission. If the State spends more than is received through tax collection, deficit could be financed in one of three ways: by monetary emission, by internal debt or by external debt, Even though there is no agreement regarding the dimension of budget deficits, figure 1 shows a trustworthy estimation of deficit financing, internally via debt and money, and by external debt.

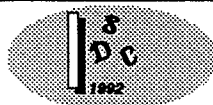
#### ARGENTINE HYPERINFLATION PROCESS.

Simply, monetary emission means too much money running after too few possessions, with the foreseeable result of inflation and this is what happened in Argentina. At the beginning of the 80's decade, argentine monthly inflation was of the 6% order. In 1983, when Alfonsin assumed the presidency, after the Malvinas' and external debt crisis, inflation had climbed up to 18% monthly, while the monetization level (M1), in relation to the GDP, had fallen from 7.9% to 4.1%, in the same period.

After two years in the government, Alfonsin had not been able to dominate such inflation. On the contrary, inflation that throughout 1984, climbed from 11% to 21% monthly, accelerated its course towards the middle of 1985 up to 25-38%. On the other hand, the government was obliged to face elections in November 1985 and could not afford either a German like hyperinflation nor a FMI style depression. In June 1985, having no other way out, Argentina set up the Plan Austral, which combined the income policy with fiscal austerity. (Dornbusch & De Pablo 1988).

#### PLAN AUSTRAL CENTRAL CHARACTERISTICS

In the first place, the Plan Austral meant prices and salaries freezing until new notice and a fix, devaluated type of change on the USA dollar. Secondly, given the sudden and no anticipated end of inflation, a scale of conversion was announced in order to adjust the existing contracts, with the aim of compensating the inertia effects of inflation. Thirdly, the *Peso* was replaced by a new currency, the *Austral*, which briefly coexisted, out of practical reasons (lack of money bills of the new denomination), with the old currency. But fourthly and above all, the Plan Austral meant an enormous fiscal adjustment, tending to reduce the fiscal deficit. In taking up such a programme, was preceded by substantial price increases for both private and public goods and services in the first half



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of June 1985. In addition, the government imposed taxes on importation and exportation, and also a forced saving plan. Taxes were increased and taxes collection accelerated. The programme was accepted by FMI and facilitated the renegotiation of the External Debt (Dornbusch & De Pablo 1988).

#### THE MODELLING APPROACH IN SYSTEM DYNAMICS.

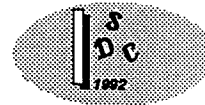
How is built a SD model setting off from an economic theory? In the first place, the differential equations which implicitly contain the dynamic of the described system are identified. The dynamic modelling in Social Sciences, particularly in Economy, frequently take up the use of differential equations. They enable us to establish the conditions which must be satisfied by the flows of the system, at any moment and time, in order to completely describe the dynamics of the system. Economists emphasize the definition of rate of changes or flows, which determine how quickly change state variables or stocks, establishing their dynamic.

In the second place, a diagram of influence around each differential equation detected in the model is constructed (omitted in this article), recognizing the feedback loops involved in the structure, at the same time that the use of theory which backs the equations is maximized. The arrows and their signs show the direction of causality and the positive or negative sense (direct or inverse) of the cause-effect relation.

In the third place, an only causal diagram is constructed, fusing the previous ones in this, as it is shown ahead in figure 1. Finally, a programme is written in DYNAMO, language or a similar one: VENSIM in this case, which is constructed following the causal lines of the diagram. Consequently, the presentation of the economic theory on this sujet occupies the next section, to proceed then, in successive sections to the formulation of the SD model. It should be mentioned that, usually, System Dynamics proceed in a reverse way. The definition of a system structure, as an adequate combination of causal feedback loops, leads to the formulation of the flows of the system.

#### THEORETICAL FRAME FOR THE INFLATION ANALYSIS

There are domestic and external financial sources to attend to the deficit which results from the difference between income and expenditure from the public sector:



Central Government, Provincial Governments and Companies in Government's hands which make up the public expenditure. While external financial sources imply to increase the stock of the external debt, the internal financial source of the State can appeal to increasing the internal debt.

#### A) DEFICIT FINANCING AND INFLATION GENESIS.

If the mentioned financial sources were not sufficient to satisfy the needs, the government simply have recourse to monetary emission. in order to finance the Treasury. The difference is made up with monetization, plus the inflationary tax. The net operating deficit is defined as the deficit which is not financed with additional indebtedness, but with monetization. According to the preceding definition, Fernández & Mantel (1985) propose the following differential equation:

$$\frac{dm}{dt} = d + br - m \pi \quad (1)$$

where:

- d = operating budget deficit as proportion of the GDP.
- r = natural interest rate;
- m = M1 as proportion of the GDP;
- b = internal debt as proportion of GDP;
- $\pi$  = inflation rate.

In the definition of deficit used in the preceding equation, the service of the external debt is included, which cannot be financed with additional indebtedness, but the service of the public domestic debt is excluded. Meanwhile, the definition of money used in the mentioned equation, corresponds to the concept of M1, in other words: currency plus checkable demand deposits. The effect Olivera-Tanzi or lost of fiscal income because of fiscal lags can be easily introduced reformulating the ec. 1 as follows, where lambda express the degree at which inflation deteriorates tax collection:

$$\frac{dm}{dt} = d + br - (m - \lambda) \pi \quad (2)$$



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B) BALANCE OF ACTIVOS AND EFFECT OF INFLATION RATE.

The balance in the assets' market is represented in the money market, where the real money stock equals the monetary demand, which is supposed to have the shape proposed by Cagan, that is to say, inverse to the interest rate: a sustained increase in the inflation rate and therefore in the interest rate, will reduce the demand of real money balance:

$$m = m^d$$
$$m = qe^{-\beta i} \quad (3)$$
$$\ln(m) = \log(q) - \beta i$$

where  $m$  is the nominal stock of money, as proportion of PBI (GDP) and  $q$  and  $\beta$  parameters. Differentiating previous equation 3, the following differential equation results:

$$\frac{di}{dt} = \frac{1}{-\beta m} \frac{dm}{dt} \quad (4)$$

where:

- $\beta$  = parameters
- $i$  = nominal interest rate;
- $m$  = M1 as proportion of GDP.

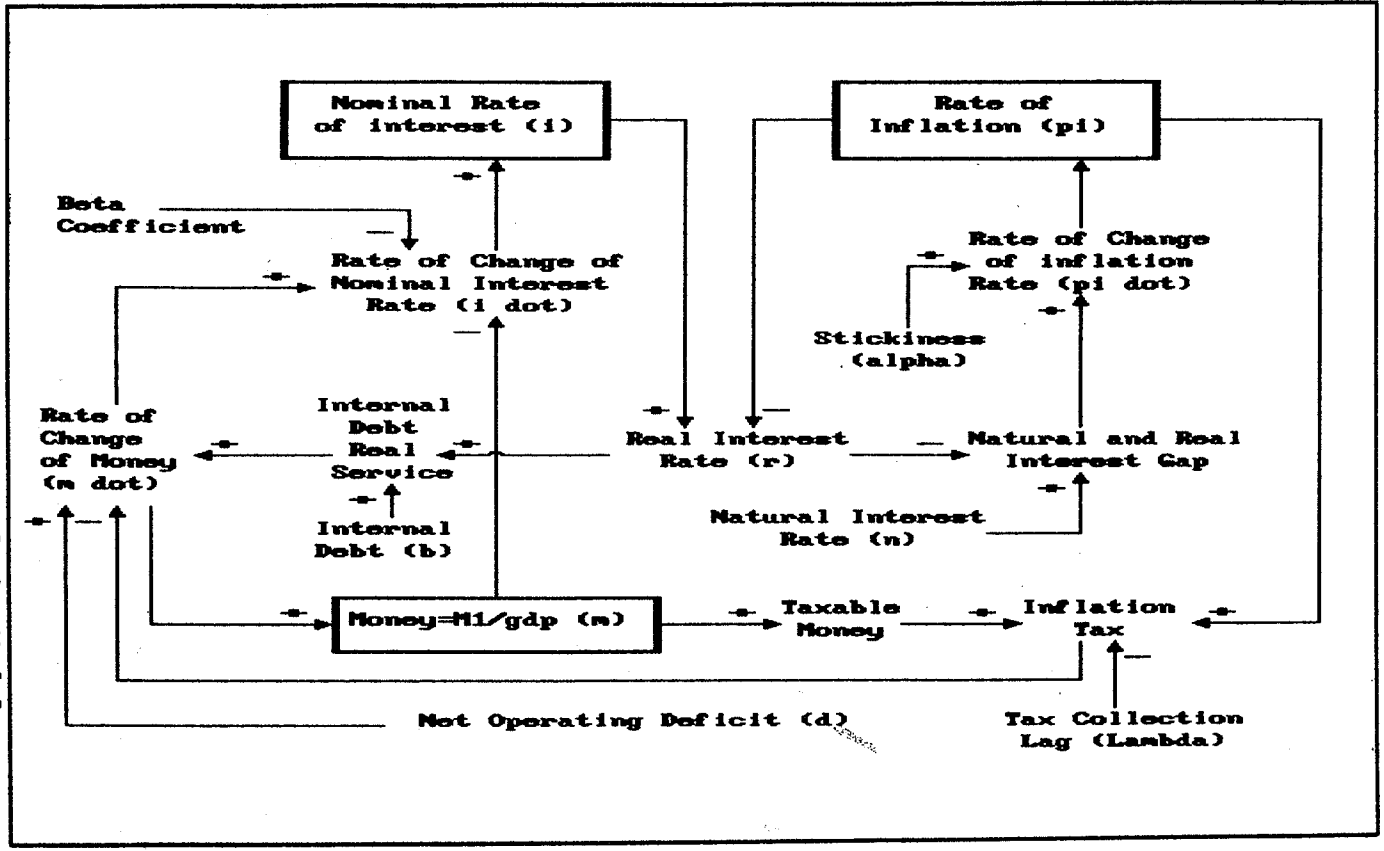
C) DYNAMICS OF INFLATION.

The rate of change in prices is simply the result of a periodical adjustment of the same, proportional to the difference between the natural interest rate and the real interest rate of the money market. As natural interest rate is understood the rate of natural growing, plus the country risk. The alpha parameter, which is supposed positive, measures the adjustment speed. On the other hand, Fisher's equation, decompose the nominal interest rate in its components, real interest rate plus inflation:  $i=r+n$ . Then, using Fisher's relation  $r=i-\pi$ , results:





Figure 1: Causal Loop Diagram of the Model.



$$\frac{d\pi}{dt} = \pi = \alpha (n - r) = \alpha [n - (i - \pi)] \quad (5)$$

The alpha coefficient introduces a sort of 'stickiness' in the prices adjustment which can be used to include the concept of prices control in the model (Fernandez & Mantel 1985). The smaller the value of alpha, the greater will be the pressure represented by the mentioned price control.

#### SD MODEL VERSION

The nucleus of modelistic tradition in System Dynamics is the idea of the feedback loop. System Dynamics organizes the factors which concurred around the phenomenon or object to be explained so as to form a system, its causal structure will be sufficient to explain the dynamics endogenously. The notion of loop is used as an intellectual trick organizing the theoretical discourse.

A loop is a sequence of causal influences which lead back to the set out point, establishing a closed circuit, such as the price-salaries spiral, or a negative loop, such as the mechanisms of inventory controls. The negative loops are by nature reinforcing elements of the system targets, while the positive loops are responsible for the exponential processes of growing or declination.

Within each loop the dynamic models include state variables (levels in the System Dynamics jargon ...figure 1) and flow variables (rates). The levels acumulate conservative amounts throughout the time, while the rates permit to represent actions or policies which lead to changes in the levels. Figure 1 represents the causal structure implicit in the previously developed theory and represented in the corresponding differential equations, 2, 4 and 5, respectively.

#### STABILIZATION PLAN SIMULATION

The initial conditions of the Plan Austral application were neatly discussed by Fernandez & Mantel (1985), analysis which is freely used here. Before the Plan Austral, the control prices were rather weak, and the inflation rate

exceeded the 30% monthly. Immediately after the plan announcement, the inflation rate is fixed in 10%, the nominal interest rate 15%, and the operative deficit is reduced to 2% of the GDP. From the start the Plan Austral announced fiscal and monetary discipline, together with a strict price control.

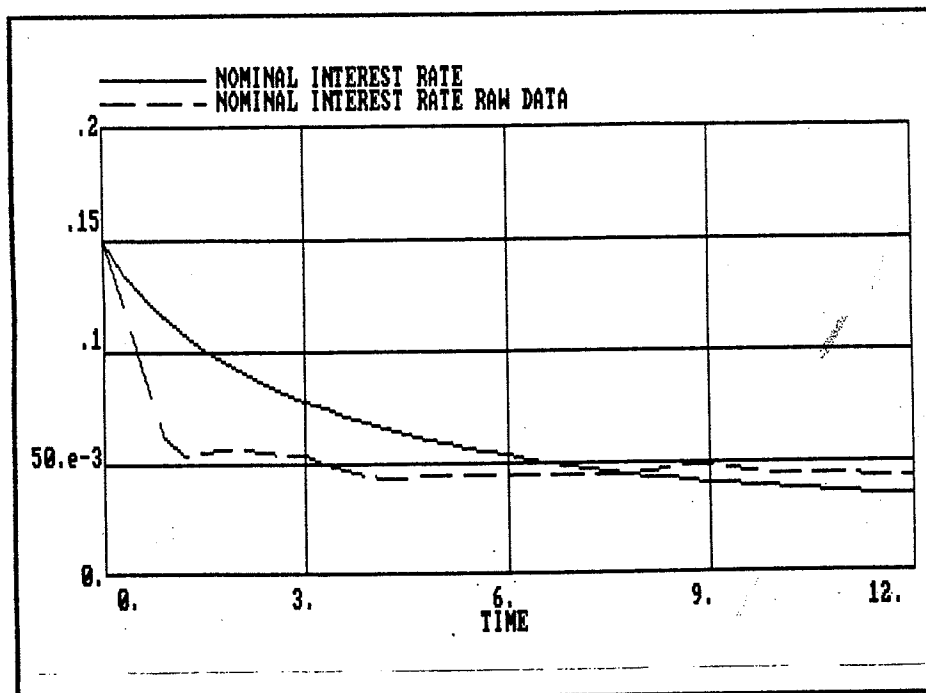
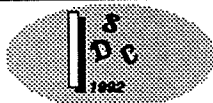


Figure 2: Plan Austral Dynamics: Simulated and Real Market Interest Rate.

The mentioned programme leaned on an energetic reduction of fiscal deficit and also in prices control, related to the parameter alpha, which, as it was said, is a measure of the 'stickiness'. It is supposed that before the application of the Plan, the parameter alpha was in the order of 15%. Even though the value assigned to the natural interest rate -1.5 % monthly- is considered high in the long term, it was considered a prudent value by Fernández and Mantel to represent the average real interest rate, immediately after the stabilization plan. The stock of the pertinent real internal debt was appraised at 80%. Respecting the values of lambda, alpha and beta, that was left to a calibration process to decide, which is available in VENSIM. This is a compiler that is still in an experimental stage. A modified Powell search selected, after





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comparing more than 12000 simulations, the following values:  $\alpha=0.04$ ,  $\beta=15.9$  and  $\lambda=0.001$ . Although the overall dynamics of the model is not quite satisfactory yet, there are some results that fit historical available data (Carteco 1987, Fischer 1985). Figure 2 above, produced by an equivalent DYNAMO versión, illustrates the dynamic trajectory of the market interest rate, contrasted with actual figures. Obviously, it falls after the Plan implementation. On the horizontal axis, zero represents the first month of application of the Plan Austral, June 1985.

#### CONCLUSION.

The reformulation of a type Cagan model, proposed from the economic theory by Fernandez & Mantel (1985), in System Dynamic terms, permits a convenient simulation of the effectiveness of the stabilization programme applied in Argentina, and known as Plan Austral, to stop. The adjustment of the model parameters to available real data about the hyperinflation which affected Argentina in 1985, was executed by a modified Powell search, available in VENSIM. Further work with the VENSIM compiler, in order to improve the correspondence of the simulation with historical facts is presently being elaborated.

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